

From Disparate Data to Accelerating Innovation: A Practical Framework for R&D Digitalization

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ABSTRACT

Manufacturing has benefited from decades of digital standardization, automation, and mature data pipelines. Digitalization in research and development (R&D)—especially in materials and process development—lags significantly due to its heterogeneous and continuously evolving datasets spanning structured measurements, semi-structured metadata, and unstructured content such as lab notes. The lack of flexible, end-to-end digital infrastructure leads to common pain points, including data loss, repeated experiments, long cycle times to derive insight, and barriers to finding and reusing prior knowledge. This work presents a practical digital transformation framework for R&D, centered on knowledge-centric platforms designed and operated as scalable digital products. At Qnity, an R&D digital transformation project focused on four tightly connected areas. First, customer insight, where direct customer feedback is translated into scalable physics-based and AI models for product development, supported by materials databases. Second, lab digitalization, which connects Qnity laboratories, enabling cross-functional teams to access critical experimental information in one place. Third, business analytics, where aggregated innovation data is used to track key performance indicators and monitor portfolio health—allowing leaders to review projects within minutes and make decisions based on evidence, with digital tools embedded directly into decision-making forums. Finally, generative AI ac-

eleration enables faster creation, search, and reuse of technical reports, patents, and project documents through a unified knowledge hub, reducing learning cycles for both new hires navigating steep semiconductor learning curves and experienced engineers seeking to leverage prior work. These platforms are intentionally integrated: lab digitalization is organized on a project basis through the business analytics system, while data from customer insights, lab operations, and business analytics feed into the generative AI platform. Yet technology alone is insufficient. Gaps between scientific intent, business value, and IT execution often emerge as teams speak different technical “languages,” leading to unclear requirements and delays in execution. The final piece is strong end-to-end ownership. Embedding a dedicated digital team into R&D with full lifecycle accountability has proven essential for delivering and sustaining long-term digital value. Qnity’s R&D digitalization has already demonstrated success in accelerating new product development timelines, shaping innovations that will define the future of advanced electronics.

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